HAER No. NV-30-A

Nevada Test Site, Test Cell C Facility, Building No. 3210
Area 25, Jackass Flats
Road J
Mercury Vicinity
Nye County
Nevada

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Western Region
Department of the Interior
San Francisco, California 94107

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HISTORIC AMERICAN ENGINEERING RECORD
NEVADA TEST SITE, TEST CELL C FACILITY, BUILDING 3210
HAER NO. NV-30-A

Location: Road J, Jackass Flats, Area 25, Nevada Test Site, Mercury Vicinity, Nye County, Nevada

USGS Jackass Flats 7.5'
UTM Coordinates Zone 11 E 564,440 N 4,076,200

Dates of Construction: 1961

Engineer: Air Products, Inc., Allentown, Pennsylvania

Builder: Unknown

Present Owner: Department of Energy, Nevada Operations Office
P.O. Box 98518, Las Vegas, NV 89193-8518

Present Occupant: Not occupied

Present Use: Vacant; no public access; to be demolished

Significance: The Test Cell C facility is significant for its role in the United States space program. The facility was part of the Rover project for the initial development and testing of a nuclear-propelled launch vehicle with goals to orbit Mars, missions to Mercury and Jupiter, and eventually, exploration beyond our solar system. Although the program did not result in an actual flight, it revealed that such missions were technically feasible and the knowledge gained is still part of the space program today. Termination of the program was in 1973.

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I. CONTEXTUAL INFORMATION

The Test Cell C facility was an integral component of the Nuclear Rocket Development Station (NRDS) operations in Area 25 (originally Area 400) of the Nevada Test Site (NTS) (Figures 1-2), originally administered by the Atomic Energy Commission (AEC) and later by the Department of Energy, Nevada Operations Office (DOE/NV). Other major facilities of the station included a second and earlier test cell (Test Cell A), a Reactor Maintenance Assembly and Disassembly (R-MAD) facility, an Engine Maintenance Assembly and Disassembly (E-MAD) facility, an Engine Test Stand (ETS-1), a Reactor Control Point complex, and the Support Area complex. The NRDS is reached from the town of Mercury by either the Jackass Flats Road directly or the Cane Spring Road via the Mercury Highway. Both routes are paved and eventually cross at an intersection at the southern edge of the NRDS complex where the 500 Gate checkpoint is located. The Test Cell C facility is located north from the intersection along Road C and Road F, passing through the Reactor Control Point complex, and turning onto Road J for about another mile.

The setting of the Test Cell C facility is toward the northern edge of Jackass Flats, an open valley at the northern extent of the Mohave Desert. Elevation of the facility is 3,820 ft (1,164 m). Yucca Mountain is to the west and southwest and Skull Mountain and Little Skull Mountain to the southeast and south. Skull Mountain reaches an elevation of almost 6,000 ft (1,829 m), while Yucca Mountain approaches 5,000 ft (1,524 m). The Calico Hills are directly north and Mid Valley and Lookout Peak are to the northeast and east, respectively. Fortymile Wash, the major drainage in the area, meanders southward along the east base of Yucca Mountain and west side of Jackass Flats and eventually joins with the Amargosa River. Topopah Wash, about 1,300 ft (400 m) west of the facility, is a smaller drainage that originates in the Calico Hills and bisects Jackass Flats north-south. Surrounding vegetation is creosote bush (*Larrea tridentata*), bursage (*Ambrosia dumosa*), blackbrush (*Coleogyne ramosissima*), Mormon tea (*Ephedra nevadensis*), thornberry (*Lycium* sp.), and in lesser amounts, other shrubs, grasses, and cacti. In the area are kit fox, desert tortoise, western shovelnose snake, the sidewinder snake, speckled rattlesnake, gopher snake, coyote, bobcat, raven, red-tailed hawk, black-tailed jackrabbit, desert and Nuttall's cottontail, long-tailed pocket mouse, kangaroo rat, desert woodrat, white-tailed antelope squirrel, black-throated sparrow, horned lark, Say's phoebe, western kingbird, loggerhead shrike, chuckwalla, side-blotched lizard, and desert horned lizard. Other animals in the region include mountain lion, chukar, Gambel's quail, morning dove, golden eagle, and occasionally, bighorn sheep and antelope. The nearest natural water source is Topopah Springs; however, several drilled NTS wells were the source of water supply for the facility when the NRDS was in operation (Space Nuclear Propulsion Office 1969:145). The first of these, J-11 and J-12, were drilled in 1957 and a third one, J-13, in 1962 when the casing failed on the first well. All were over a thousand feet deep. The wells served two interconnected water delivery systems, one for the northern area of the NRDS and the other for the southern, with each system serving as a backup to the other, particularly for emergencies, such as fire.

The mission of the NRDS, managed by the Los Alamos Scientific Laboratory (now the Los Alamos National Laboratory), University of California, was to develop and test nuclear rocket engines and reactors during the Rover project for the space program of the United States (AEC 1961:69; House 1963). The objective in the development of this type of nuclear engine was to enable the United States to undertake long and complicated journeys not possible at the time with existing methods (House 1963; Schreiber 1961:25, 29). The program at the NTS began in 1957 and ended in 1973 (AEC 1974:23; Friesen 1995:1; Miller 1984:5). The Test Cell C facility has been determined eligible to the National Register of Historic Places through consultation between DOE/NV and the Nevada State Historic Preservation Office and is currently slated to be demolished under the Environmental Management Deactivation and Decommissioning Program (Carlson 1999).

The primary structure of the facility is the test cell (Building 3210) where nuclear reactors and engines were tested (Figures 3-5). Other support buildings include an air intake building (Building 3205), a pump house (Building 3220), an operations building (Building 3229), a motor drive building (Building 3230), and a cryogenic evaluation laboratory (Building 3232). Building 3228, a semi-permanent, metal maintenance and shop warehouse, once located by the operations building, has apparently been taken down and removed from the site. Two electric substations are present, one toward the southeast corner of the compound and the second one along the western edge. A secured radiography area is attached at the southeast corner of the facility. The complex also features five dewars, a 150,000 gallon elevated water tower, a surface 150,000 gallon water reservoir tank, and abundant piping (Photograph 30-B-1). The entire facility is bounded by a chain link fence, with the main entry from the south side where a large paved parking area and the main operations building and maintenance yard are located. Secondary gates in the fence are positioned at the train tracks entering and leaving the facility and at key locales where people can enter or exit through smaller personnel gates from the other cardinal directions. Two wooden camera bunkers, one to the west (Photograph 30-C-1) and the other to the north, stand outside the fence. Railroad tracks extend northward from the north face of the test cell to a tall, corrugated metal shed inside the fence, where the reactors were stored from the weather and final adjustments made before the tests. These railroad tracks also connect to the overall railroad system for the NRDS by which test reactors and engines and other equipment were transported between the different facilities. At the R-MAD and E-MAD facilities the reactors and engines were assembled and later disassembled after being tested at Test Cell C.

II. ARCHITECTURAL AND ENGINEERING INFORMATION

The Test Cell C facility, constructed in 1961 (Space Nuclear Propulsion Office 1969:67), was used to ground test nuclear reactors and engines for rockets. The primary structure, Building 3210, is toward the northern portion of the site complex. The original dimensions of the building were about 80 ft (24 m) in length, 63 ft (19 m) wide, 36 ft (11 m) high above the ground surface, and with a floor area of 10,350 sq ft (962 sq m). A later addition to the ground floor on the west side of the building added another 1,830 sq ft (170 sq m) of floor space. The basement followed the same footprint as the original ground floor. A small penthouse forms the second floor. The walls, with the exception of the north wall, are about 1.75 ft (0.5 m) thick, consisting of reinforced concrete. The north wall, also of reinforced concrete, is where the reactor was placed for testing and is 5.5 ft (1.7 m) thick.

Building 3210 is mostly a high, one-story flat-roofed structure. The exterior is a complex, reinforced concrete mass surrounded and intersected by pipes, ducts, and equipment (Figures 6-9). The center portion of the north elevation where the reactor was placed for testing includes vertical inset grooves, cylindrical plates, wall-mounted equipment and stainless steel doors (Photographs NV-30-A-1 and NV-30-A-2). The shielding wall angles forward and up at the west end. The east end is lower, and like the west end, has no building behind it. Low walls project from the eastern section of the wall and equipment, such as tanks and a steam generator, occupy the areas between them. The west elevation seen today is that of the addition to the test cell (Photograph NV-30-A-3). This high, one-story concrete wall features a plywood-enclosed loading door and large pipe penetrations connecting the building to the nearby dewar. The south elevation from west to east includes the later addition to the test cell (Photograph NV-30-A-4), the freight elevator, and the original portion of the building, which is at a lower height than the addition. The addition is also set back from the face of the original building. Pipe railing stands at the top of the wall and large ducts and steel plates mounted low are attached to the addition. This elevations also features doors to the flow control room and the high pressure room, stairs down to the basement, and stairs up to the penthouse. The east elevation is mostly one story, with pipe railings along the roof (Photographs NV-30-A-5 and NV-30-A-6). High, three-light windows are along the top portion of the wall, which features wall-mounted gauges at its lower reaches. A wide roof projection overhangs the wall.

The basement consists of four rooms (Figure 10): a large mechanical equipment room along the entire west and south sides of the building; a narrow electronics room in the northeast corner of the building; a small forward control room; and a small, raised room projecting north and outside from the northeast corner of the main building footprint. The Mechanical Equipment Room is essentially an L-shaped, concrete-encased room, with a twelve feet high ceiling (Photographs NV-30-A-7 to NV-30-A-10). Access is made by staircases at the northeast and southeast corners, as well as a freight elevator at the southeast corner. The stairs at the north end have been reconfigured since the original 1960 floor plan drawings and is attributed to modifications for the first floor addition. Three concrete piers supplement concrete bearing walls to support the ceiling and structure above. Plywood form work marks are visible on walls and ceiling. The room is filled with pipes and ducts. Large pieces of mechanical equipment stand along the east wall. Ladder-like metal tracks below the ceiling carry wiring. Lighting fixtures are white metal shades with large glass globes.

The Electronics Room (Photographs NV-30-A-11 and NV-30-A-12), also L-shaped, features a vinyl-asbestos-tile-over-concrete floor, and concrete walls with horizontal grooves, called out on drawings as embedded unistrut, running entirely around the room, evenly spaced at approximately two feet intervals. A metal track runs overhead, below the ceiling, carrying wiring. The ceiling finish is painted perforated asbestos paneling over mineral wool. Its door, at the south end of room, is approximately three inch thick steel with an enormous panic bar on the inside face that is marked with the name"Pogh." The outside face has a huge handle and rod opener. The Forward Control Room is a small, nearly square room containing electrical panels and wires (Photograph NV-30-A-13). It features floor, wall and ceiling treatments similar to the Electronics Room. This room is also entered by an enormous door identical to that described for the Electronics Room. The fourth room in the basement is reached by four riser steps (Photograph NV-30-A-14). It is rectangular, approximately 10 ft (3 m) wide in the east-west direction by 20 ft (6 m) long in the north-south direction. The room has a concrete ceiling and floor. The concrete walls have vertical unistrut imbeds instead of the horizontal ones seen in the Electronic and Forward Control rooms. A large piece of equipment stands at the center of the room.

The first floor (Figure 11), or ground floor, includes a nearly square original section with four rooms and a one-room addition to the west. Rooms in the original portion include a Flow Control Room, the largest in the building; a small Hookup Room, immediately north of the Flow Control Room; an Experimental Room, north of the Flow Control Room and east of the Hookup Room; and a High Pressure Room occupying the entire east side of the floor plate. The Addition (Photographs NV-30-A-15 to NV-30-A-17) is on the west side of the building, tucked between the freight elevator and the northern staircase to the basement. The room features a concrete floor, walls, and ceiling. A metal catwalk is near the ceiling. Abundant electrical panels and conduit are mounted on the walls. Three cylindrical tanks topped by meters stand along the west wall. Big, floor-mounted metal equipment stands at the north and south ends. Entry into the room was from the west, through a large bay, now infilled with wood studs and plywood. Industrial lantern-like fixtures lit the space. A crane is mounted on the ceiling. The concrete-encased Flow Control Room (Photographs NV-30-A-18 to NV-30-A-20) has a lower ceiling than the Addition. Its raised metal-grate floor, at approximately three feet above the concrete slab, runs between large pieces of floor-mounted equipment. Pipes run continuously beneath the floor grate. A metal pipe guardrail edges the platform. A large circular raised equipment mount occupies the southern end of the room. A large assemblage of pipes and ducts occupies the central area at the north end of the room. White metal industrial ceiling fixtures lit the space. The Hookup Room features concrete floor, walls, and ceiling (Photograph NV-30-A-21). Gauges and equipment mount to the walls. A 2 inch thick steel plate door, over a raised 3.5 inch high by 16 inch deep threshold, accesses the space from the Flow Control Room. In addition, an approximately 3 ft wide by 8 inch high horizontal opening penetrates the top of the wall separating the Flow Control Room and the Hookup Room. A ladder and ceiling hatch along the western side of the room leads to a space above, off-limits at the time of survey because of radiation. Lighting consists of flush-mounted flat squares in the ceiling, consisting of translucent lenses set into steel frames. The Experimental Room features concrete floor, walls, and ceiling, and is filled with equipment (Photograph NV-30-A-22). It is located east of the Hookup Room and off the Flow Control Room. The narrow and rectangular High Pressure Room (Photograph NV-30-A-23) is oriented north-south, along the east side of the building, and has a double door access to the outside on the south wall (see Photograph NV-30-A-6). The ceiling slopes up to the east. A metal grate platform and two steps ascend to the adjacent Flow Control Room. The stairs occupy the southwest corner of the room. Conduit, equipment, and meters are mounted on all walls. Green-glazed windows, high on the east wall, allow some natural light. The north wall features a posted sign reading "shielded reactor wall." Table-like equipment runs all along the east wall. At the ceiling are more ducts, pipes, and conduit. Lighting consists of white enameled metal shaded industrial fixtures.

The Penthouse occupies the northern end of the roof (Photograph NV-30-A-24), situated directly over the Hookup and Experimental rooms (Figure 12). Inside are two rooms. The east Detector Room (Photograph NV-30-A-25) is windowless, concrete-encased, and features bays of electrical panels similar to the basement. Metal runs of conduit are above head, but below ceiling height. The west Neutronics Room (Photograph NV-30-A-26) has concrete floor, walls, and ceiling. A double set of paired steel doors enter the room from the roof in the middle of the south wall. An approximately four inch high raised concrete platform begins at the door. A steel mezzanine occupies the center of the room, with a steel-grate staircase and floor. A ladder-type wire mount attaches to the east wall, higher than the door.

III. HISTORICAL INFORMATION

The concept of nuclear-propelled rockets was initially discussed in 1944 by personnel at both LASL and the University of Chicago Metallurgical Laboratory (Bussard 1962:169; Bussard and DeLauer 1965:1). Following these discussions, the first serious study dealing with the concept of nuclear rockets, aircraft, and ramjets was produced in 1946 as a secret document by personnel at the Applied Physics Laboratory, John Hopkins University (Bussard 1962:169; Bussard and DeLauer (1965:2). This document summarized the contemporary information about nuclear propulsion and the principles and problems for developing such systems. What was made evident in the document was that little or nothing was known about specific properties of materials in order to build the systems. A second secret document was prepared in 1947 by the Aerophysics Laboratory, North American Aviation Corporation, focusing on nuclear ramjets and rockets of different sizes for military purposes (Bussard 1962:170; Bussard and DeLauer 1965:2).

In 1946, the U.S. Air Force established the Nuclear Energy for Propulsion of Aircraft (NEPA) project at the Oak Ridge National Laboratory, Tennessee for exploring the possibility of low-altitude nuclear aircraft (Bussard and DeLauer 1965:2; Larson 1950:2). Work on this project continued intermittently until 1949 (Bussard 1962:170). The Lexington

Project, an ad hoc study group convening in 1948 at the Massachusetts Institute of Technology at the behest of the AEC, determined the least difficult system to develop was the low-altitude nuclear aircraft, followed by the nuclear ramjet for powering missiles, with the nuclear rocket being the most difficult. The NEPA project evolved into a new and expanded Aircraft Nuclear Propulsion (ANP) program in 1951 when the U.S. Air Force joined with the AEC to develop the systems, focusing primarily on manned military aircraft (AEC 1956). In 1955 the U.S. Navy also became interested and requested a feasibility study for a nuclear-powered seaplane (AEC 1956). The ANP program ended in 1961, however, with few results (Bussard and DeLauer 1965:4). In contrast to the earlier beliefs, it was found that a nuclear-propelled low-altitude aircraft was the most difficult of the three systems to develop, due mostly to size constraints and safety considerations. Furthermore, it was determined little advantage was to be gained in developing ballistic missiles powered by nuclear engines. Chemically-propelled missiles had already been developed, and effort and money could be spent elsewhere (Baker 1996:62; General Advisory Committee 1960:28).

In the 1950s, an article by Bussard (1953), who was working at the Oak Ridge National Laboratory at the time, on the potentialities of a wide range of missions for nuclear rockets, sufficiently influenced the U.S. Air Force to direct, through the AEC, the LASL and UCRL to study the feasibility of linking nuclear power with rockets (AEC 1962:71; Baker 1996:48-49; Bussard 1962:170; Bussard and DeLauer 1965:3; General Advisory Committee 1956:18-24; House 1963). The great appeal of nuclear propulsion, as opposed to chemical propulsion, was its smaller size and greater velocity to enable bigger payloads. Consequently, it was considered more efficient and preferable than chemical systems, particularly in the long and complex journeys for exploring the solar system (see Angelo and Buden 1985:ix; Schreiber 1961:25, 29). In 1955, the Condor committee of the U.S. Air Force Scientific Advisory Board recommended that work was to begin on a nuclear-propelled rocket (Baker 1996:55; House 1963). In 1957, a Rover reactor approach using uranium-loaded graphite fuel was selected as the method to be developed based on the studies by LASL and UCRL (AEC 1962:71). Construction and testing of reactors for rockets was assigned to LASL within the Rover project, while UCRL was given a similar task for ramjets, thereafter referred to as the Pluto project (AEC 1958a, 1958b; Schreiber 1958:70).

The NTS, with a record of nuclear weapons testing, including atmospheric or above ground tests, was chosen as the place to conduct the nuclear reactor tests because of the possibility of an excursion within the reactor, and also, the tests released a radioactive exhaust plume into the atmosphere that was acceptable for the NTS at the time (AEC 1958a; see Bernhardt et al. 1974; House 1963; see Friesen 1995). Initial development of the NRDS in 1956 was a joint AEC and U.S. Air Force effort that eventually evolved into an AEC and National Aeronautics and Space Administration (NASA) project (AEC 1957:10, 1958a, 1961:71, 1964:109; Baker 1996:57; Beck et al. 1996:26; House 1963; Miller 1984:1). In 1961, the NRDS area, about 318,000 acres, was officially withdrawn to the AEC from the Nellis Air Force Range under Public Land Order 2568 (Space Nuclear Propulsion Office 1969:75). The mission of the AEC was to develop nuclear reactors and reactor technology, while NASA, who had taken over the role from the U.S. Air Force, had the responsibility to develop nuclear engines and engine technology and for the integration of the reactors into engines (AEC 1963:168). Administration of the program was by a newly created Space Nuclear Propulsion Office located in Georgetown, Maryland, headquarters of the AEC, with operating extensions in Albuquerque, Cleveland, and Las Vegas.

The primary mission of the NRDS at the NTS was to support the Rover project in developing nuclear rocket reactors and engines for the space program (AEC 1961:69; House 1963; Miller 1984:1). Initially, three stages were outlined for the program. The first stage was to develop test reactors in order to investigate and solve various problems in achieving a high-power density, to develop reactor materials capable of withstanding high temperatures, and to generate new concepts for converting nuclear energy into useful propulsion forms (AEC 1960:77). The second stage was to develop and test a nuclear engine for actual flight and the third stage, performed by NASA, was to incorporate the engine into a Saturn V launch vehicle for flight testing (AEC 1964:109; Schreiber 1961:33).

The first nuclear rocket test reactor at the NRDS, designated Kiwi-A, was conducted in 1959 (AEC 1961:69; Bussard and DeLauer 1965:3; Schreiber 1961:29). More test series followed, including NRX, Phoebus, Pewee, XE, and Nuclear Furnace (Angelo and Buden 1985:179-183; DOE/NV 1985:2-2, Table 6.2.1; Friesen 1995). Following the initial outline of the Rover project, the objective of the Kiwi test series was to develop the reactor technology and design (Schreiber 1958:70). The ground-based Kiwi reactor, appropriately named after a flightless New Zealand bird, would become the basic design for the NERVA (Nuclear Engine for Rocket Vehicle Application) engine to be flight-tested in the RIFT (Reactor in Flight Test) vehicle (AEC 1963:168, 1965:111). The RIFT vehicle would then be developed for an upper stage on an advanced Saturn rocket, capable of putting large payloads on the moon for lunar-based missions. The module would also be used for manned missions to Mars or Venus (AEC 1967:181).

The purpose of Test Cell C was to test the nuclear reactors being developed for the United States space program. The facility, an upgrade of the earlier Test Cell A and capable of larger and more powerful tests, was constructed in 1961, with camera bunkers added in 1964, and the maintenance and supply building (Building 3228) and the operations building (Building 3229) added in 1966 (Space Nuclear Propulsion Office 1969:66-67). In 1961, President John F. Kennedy toured the AEC facilities in New Mexico and Nevada for the purpose of receiving briefings on the Rover project, and at the NRDS he inspected the R-MAD, Test Cell C, and ETS-1 (AEC 1963:172). At the R-MAD he witnessed a portion of the disassembly of the Kiwi B-4A reactor. This event marks the only time a President of the United States has visited the NTS.

All operations at Test Cell C were designed to be operated remotely from the Reactor Control Point located about 2 miles (3 km) to the south, and during tests the facility was vacated, being remotely controlled from this other location (Space Nuclear Propulsion Office 1969:101). During such tests the reactors, staged on a railroad car for ease of transportation between facilities, exhausted skyward. In contrast, the later and more advanced XE, designated for Experimental Engine, exhausted downward and was tested at ETS-1, constructed in 1966 specifically for this purpose (AEC 1969:161; Space Nuclear Propulsion Office 1969:68). In the latter the engine was placed in the stand and not attached to a railroad car. Effluent exhausted from these reactor tests contained radioactive materials in various quantities determined by the amount of power generated and rose thousands of feet above the ground (Bernhardt et al. 1974; Friesen 1995:7). LASL developed the Kiwi, Phoebus, and Pewee reactors and the Westinghouse Astronuclear Laboratory at Large, Pennsylvania developed the NRX and XE reactors (AEC 1961:69, 1968:164; Friesen 1995:6).

The first reactors tested, initially at Test Cell A and later at Test Cell C, were the Kiwi series. The Kiwi A was the first full power reactor and provided the fundamental information on fuel element design and reactor control (Friesen 1995:5). Objectives of later ones in this series were "to explore a somewhat different problem and incorporated advances made from the preceding ones" (AEC 1964:110). For example, Kiwi B 1B and B 4A reactors demonstrated the use of liquid hydrogen as a coolant at power levels and temperatures for space missions (AEC 1963:169; Friesen 1995:5); Kiwi B 4A, B 4A CF, B 2A, and B 4B reactors tested design changes to eliminate core damage from flow vibrations of liquid hydrogen (AEC 1964:110; Friesen 1995:5); and the Kiwi B 4E was the first reactor fueled by uranium carbide beads (Friesen 1995:5). In 1965, a safety test known as the Kiwi Transient Nuclear Test was conducted on a railroad trestle just west of Test Cell C and a Kiwi reactor was deliberately destroyed by subjecting it to a very fast power increase (AEC 1966:146; Friesen 1995:5; Miller 1984:5). The aim of the experiment was to determine the effects of a nuclear reactor explosion under launch conditions.

Phase two of the Rover project was NERVA, an Aerojet General/Westinghouse effort to provide the technology for a complete nuclear rocket engine capable of flight based on the Kiwi reactor design and technology (AEC 1966:142, 1968:169). Test Cell C was used for testing NERVA reactors, while testing of the engine systems was conducted at ETS-1. At Test Cell C these included the NERVA Reactor Experimental (NRX) reactors (AEC 1964:113). In 1966, the NRX A4 EST was the first test consisting of all the engine components, although arranged in a breadboard design for test convenience. It was also the first to bootstrap or self-start, demonstrating that a nuclear-powered rocket could start and operate on its own power (Friesen 1995:6). The XE Prime was the first engine to be tested, at the ETS-1, in the correct flight configuration, that is, all the parts were put together in the proper sequence. In 1967, the NRX A6 operated at full power for one hour.

In late 1963, the Rover project was revised, emphasizing ground-based research and engineering. That is, the Kiwi project was unchanged, worked continued on the NERVA engine technology, but the planned RIFT stage was cancelled (AEC 1964:110). Continuing with the post-Kiwi research aspect of the Rover project, were the Phoebus reactors, named after the Greek sun god, and Pewee reactors, designed as a small test-bed reactor using fewer fuel elements and operating at full power and temperature (AEC 1970:166; Friesen 1995:6). The Phoebus reactor was designed to be more powerful (Watson 1994:20). In 1965 at Test Cell C the first Phoebus test was conducted at full power, but during shutdown the liquid hydrogen coolant to cool the reactor was exhausted because of a gate malfunction in the fuel storage tank and the reactor core was damaged from overheating (AEC 1966:146). In 1966, modifications to the test cell were completed for further testing of the Phoebus reactor series (AEC 1967:193). Major improvements were the addition of two 500,000 gallon liquid hydrogen storage dewars, an emergency pressurized liquid hydrogen storage dewar for supplying hydrogen coolant to a reactor in the event of a feed system failure, and the NFS 3B, a high capacity liquid hydrogen feed system. The Phoebus 2A was the most powerful reactor ever developed and capable of reaching 5,000 megawatts. In 1968 it successfully operated at full power for twelve minutes with over 4,000 megawatts generated and intermediate power for twenty minutes (AEC 1969:159; Friesen 1995:6).

In 1968, the test cell was again modified to handle the testing of the Pewee reactor. These changes consisted of adding a new liquid-hydrogen feed-system turbopump and minor alterations to various lines and valves to accommodate reduced flow requirements (AEC 1969:160). The Pewee reactor program was implemented to check corrosion of the fuel element for the NERVA engine (AEC 1970:166). This small reactor uses only a few fuel elements in contrast to the larger reactors, and therefore, was largely an economical decision to use. The greatest effect on a fuel element during reactor operation is corrosion of the graphite by hot hydrogen. The higher the temperature, the greater the corrosion. The program essentially consisted of improving fuel element coatings to resist the corrosion. The last of the nuclear reactors tested at Test Cell C was Nuclear Furnace in 1972. Nuclear Furnace, also used to evaluate fuel elements, was designed and built at LASL (AEC 1971:176). The turnaround time was quicker than the Pewee reactors so more experiments could be conducted. It also holds the record for total time at full power for 109 minutes (Watson 1994:24).

Early in 1972, the NERVA project was cancelled (AEC 1973:25). Eventually, further budget restrictions in 1973 led to a termination of all space-oriented nuclear propulsion development efforts and the entire program at the NTS was phased out by the end of the fiscal year. Despite this somewhat abrupt ending, the significant technological advances made during the Rover project proved the feasibility of nuclear-propelled space vehicles and constitute the primary building blocks for future explorations of the solar system and beyond in the twenty-first century (Angelo and Buden 1985:194; e.g., Porta 1995; Watson 1994).

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V. PROJECT INFORMATION

This manuscript has been prepared at the request of the Department of Energy, Nevada Operations Office in response to the management of cultural resources on the Nevada Test Site. It is based on a previous investigation conducted by the Desert Research Institute, reported in Cultural Resources Reconnaissance Short Report No. SR021500-1, *An Historical Evaluation of the Test Cell C Facility for Characterization Activities Associated with Decontamination and Decommissioning, Area 25, Nevada Test Site, Nye County, Nevada*, 2000. Project Manager and Co-Principal Investigator for documentation of the facility was Colleen M. Beck of the Desert Research Institute, Las Vegas, Nevada; Harold Drollinger of the Desert Research Institute, Las Vegas, was the second Principal Investigator; Nancy Goldenberg of Carey & Company, Inc. Architects, San Francisco, California was the historic architect; and the photographer was Richard Smith of Bechtel Nevada, Las Vegas.

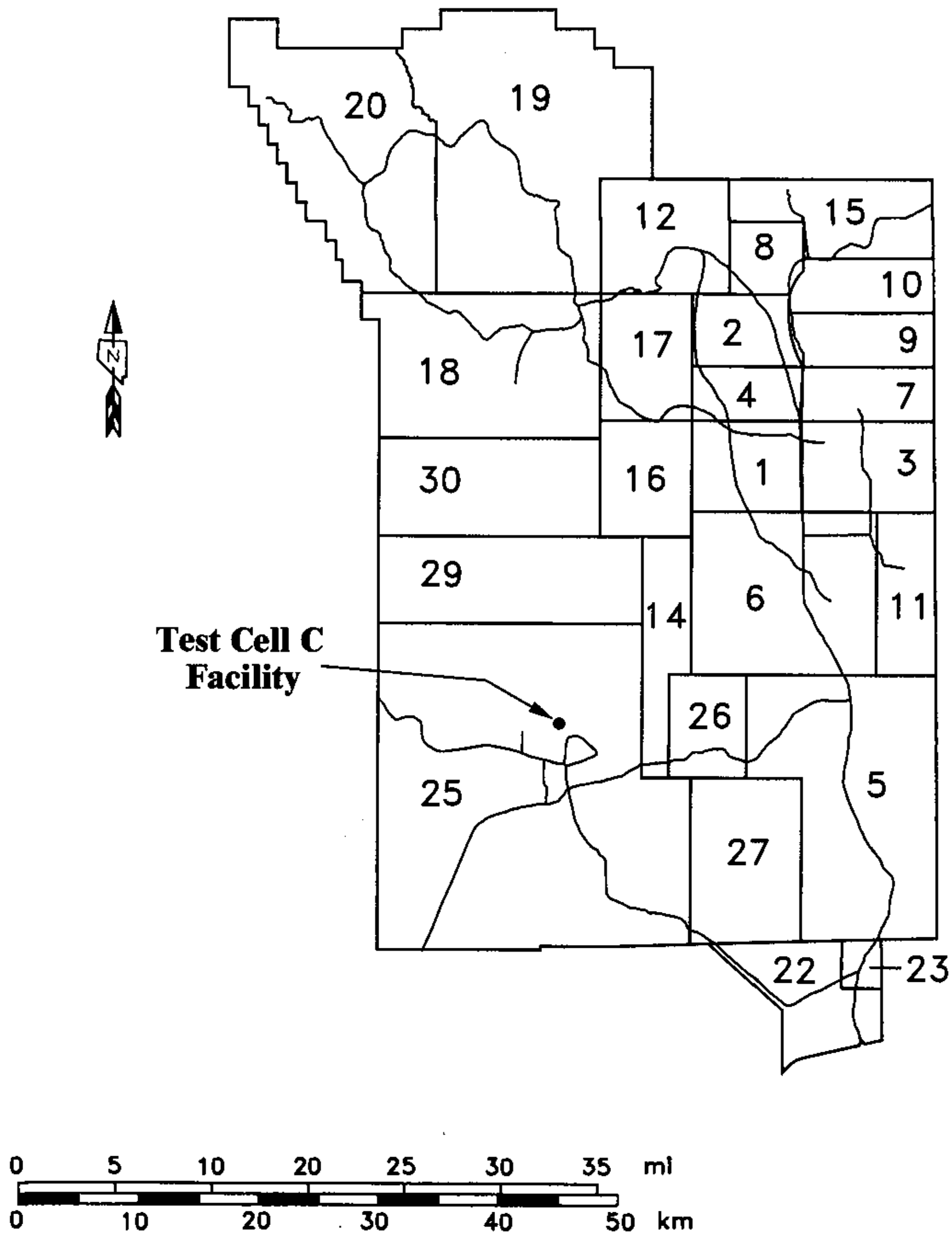

Figure 1. Location of the Test Cell C Facility on the Nevada Test Site.

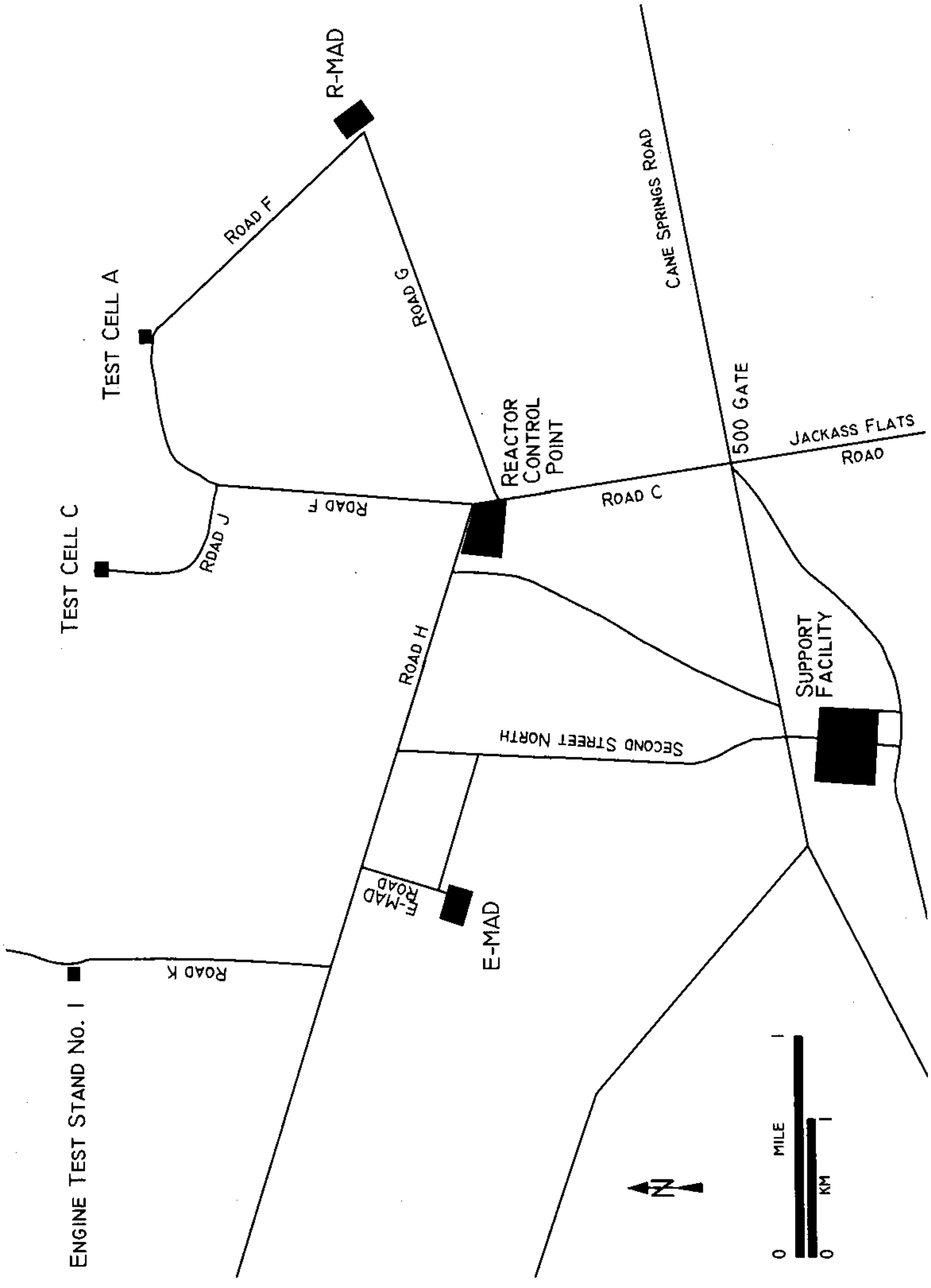

Figure 2. Major facilities of the Nuclear Rocket Development Station.

Figure 3. Aerial view south of Test Cell C Facility, with nuclear reactor emplaced for testing, ca. 1967.

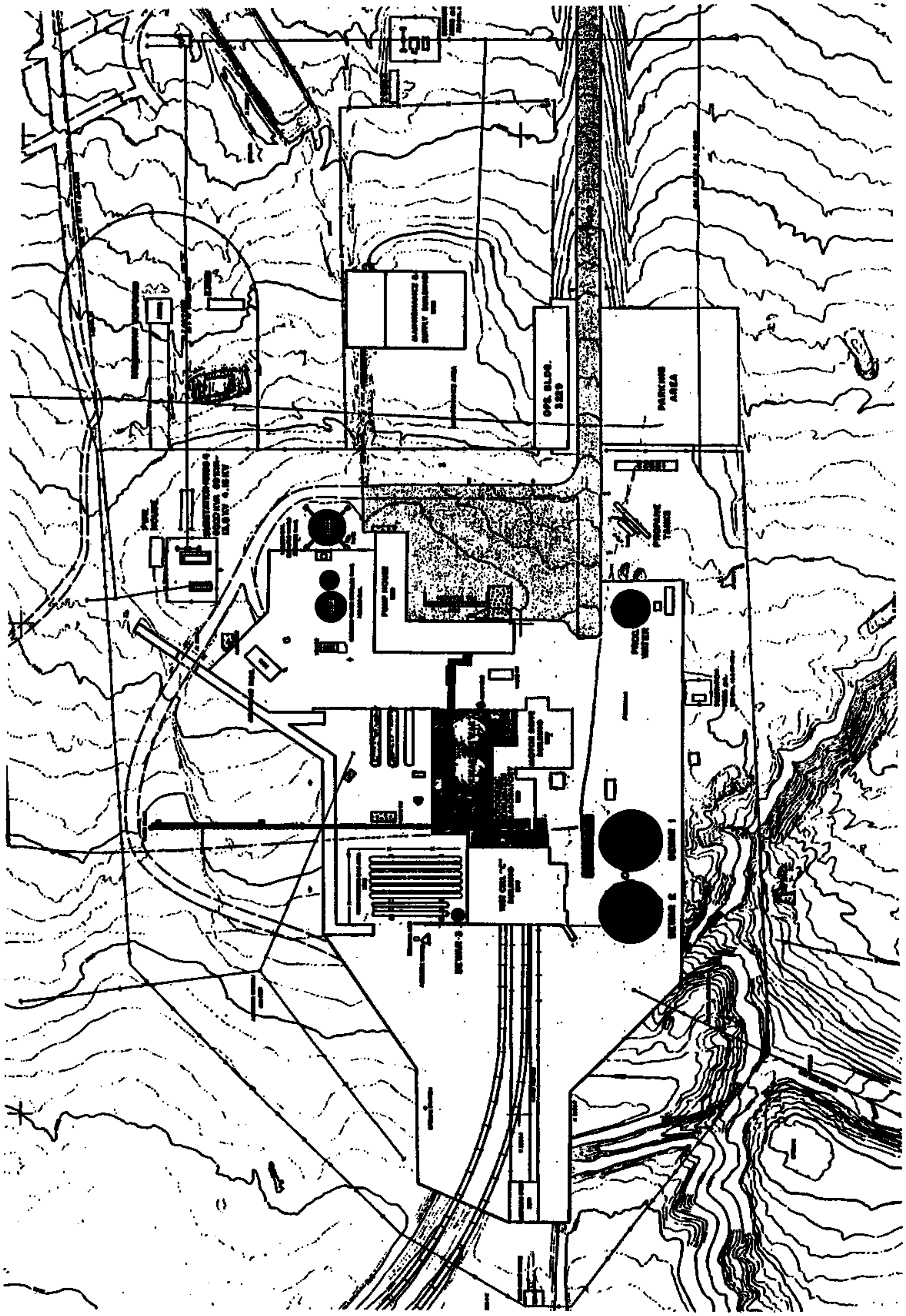

Figure 4. Plan map of the Test Cell C Facility, ca. 1965.

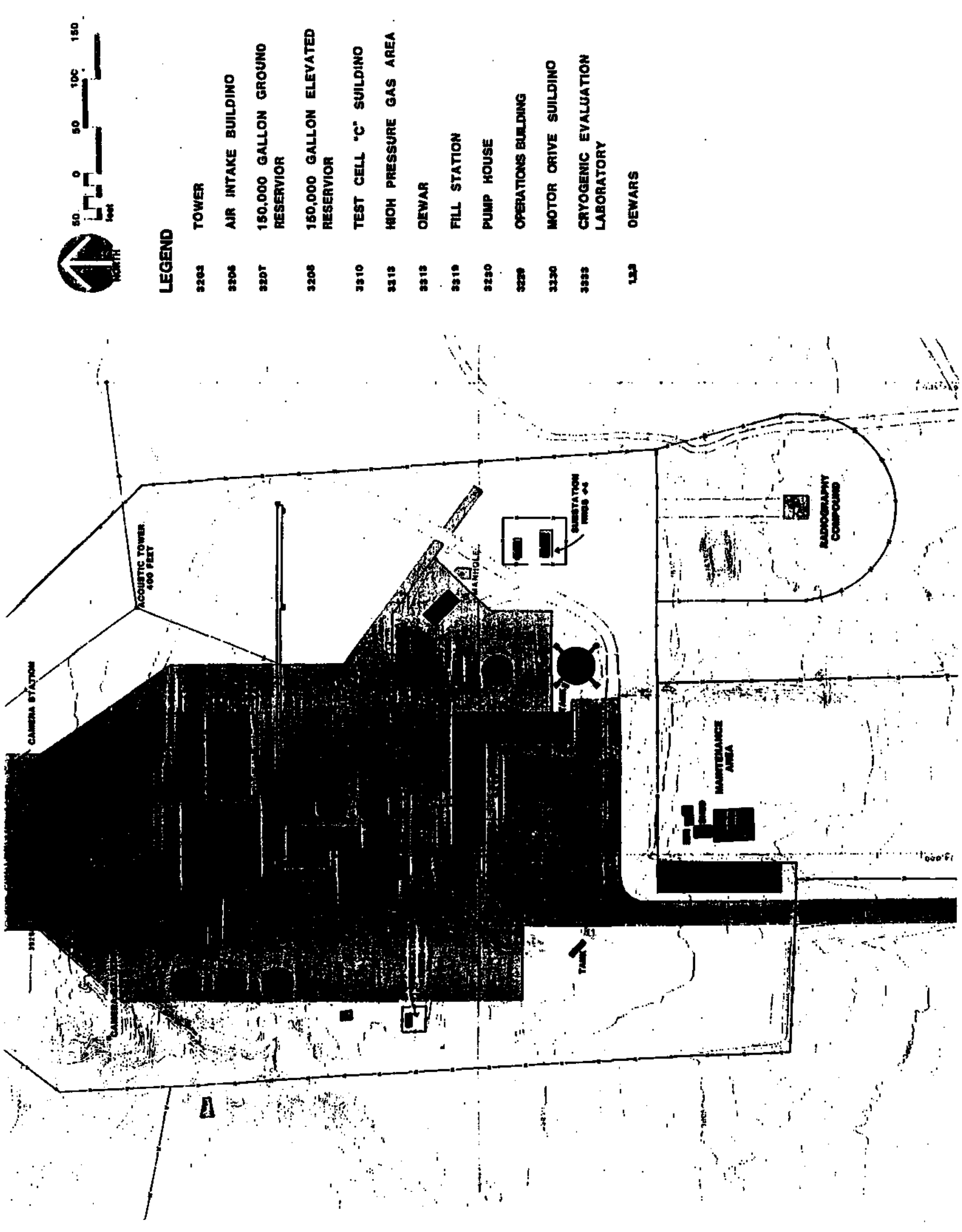

Figure 5. Plan map of the Test Cell C Facility, ca. 1994.

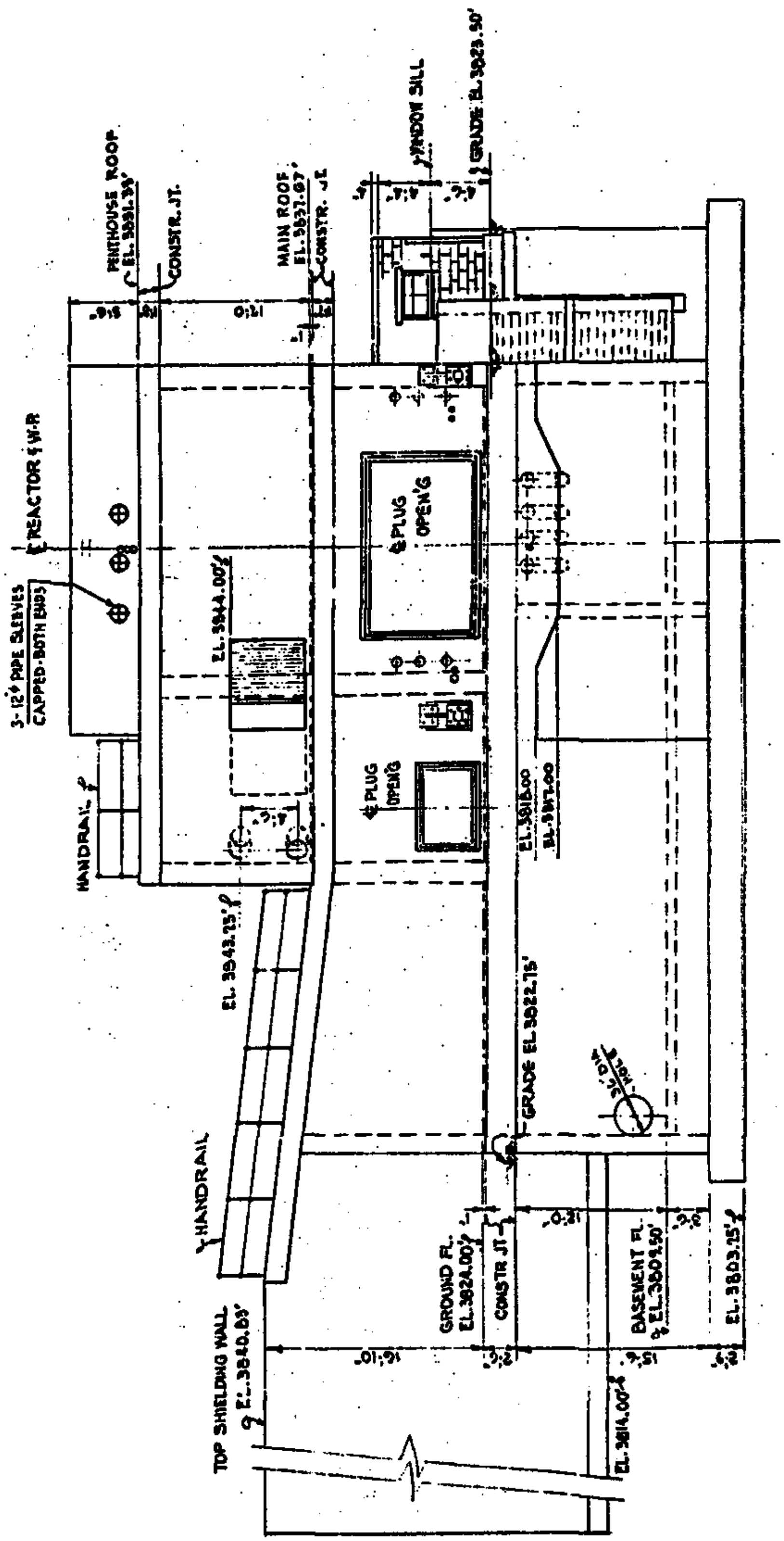

Figure 6. Test Cell C, Building 3210, north elevation, ca. 1960.

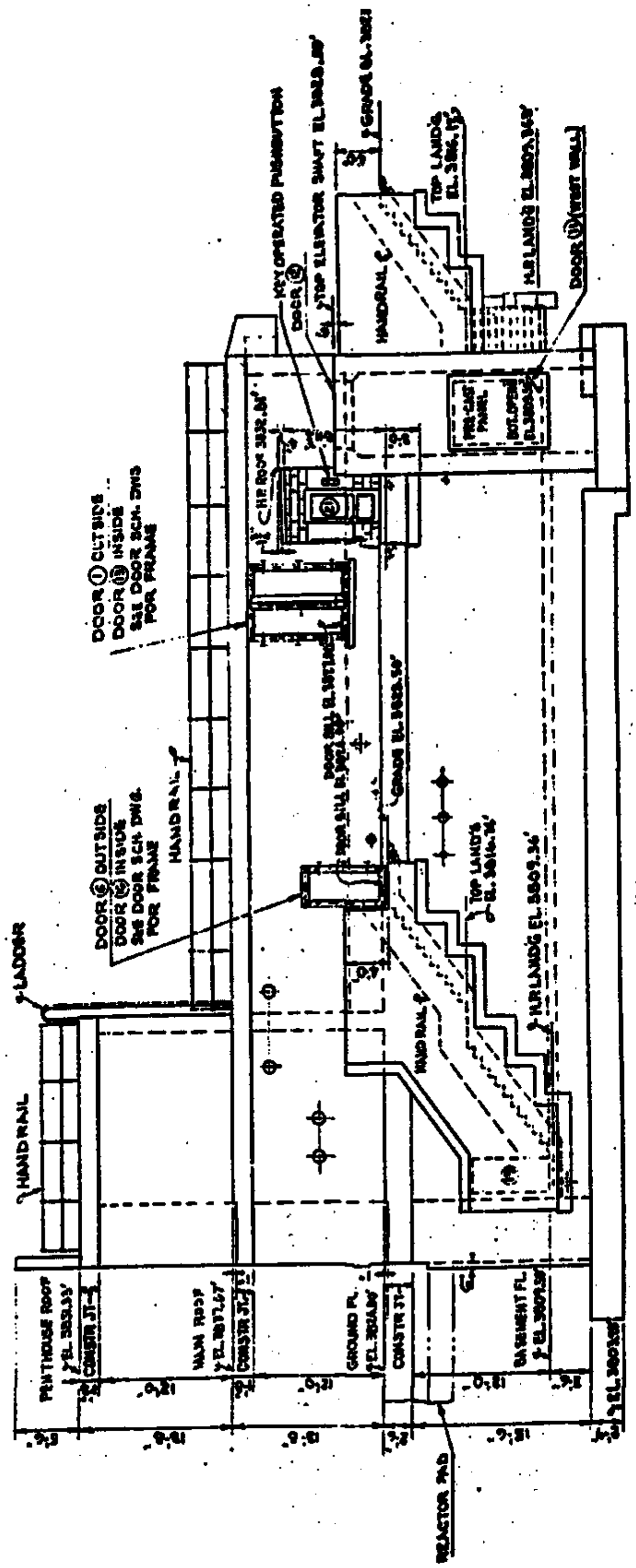

Figure 7. Test Cell C, Building 3210, west elevation, ca. 1960.

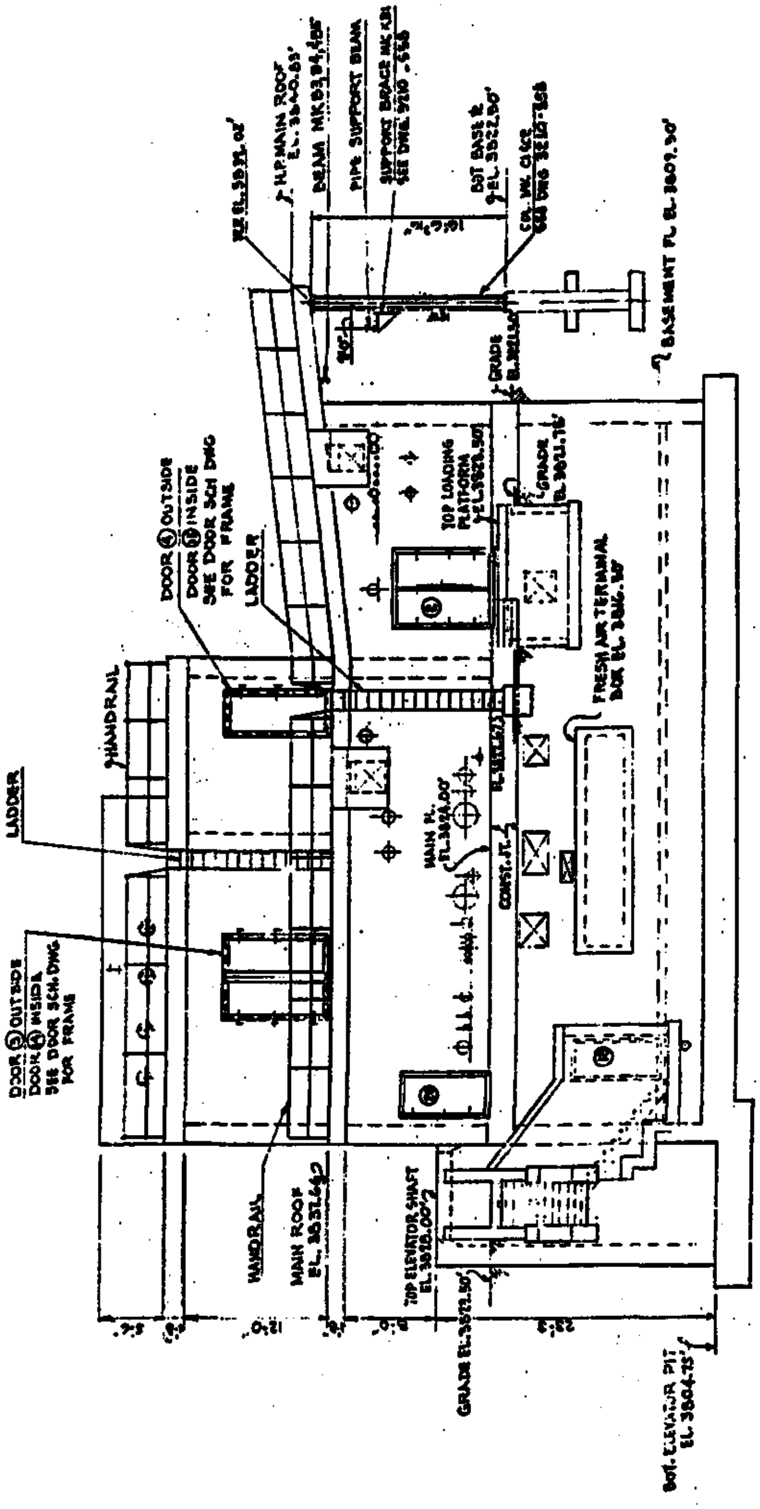

Figure 8. Test Cell C, Building 3210, south elevation, ca. 1960.

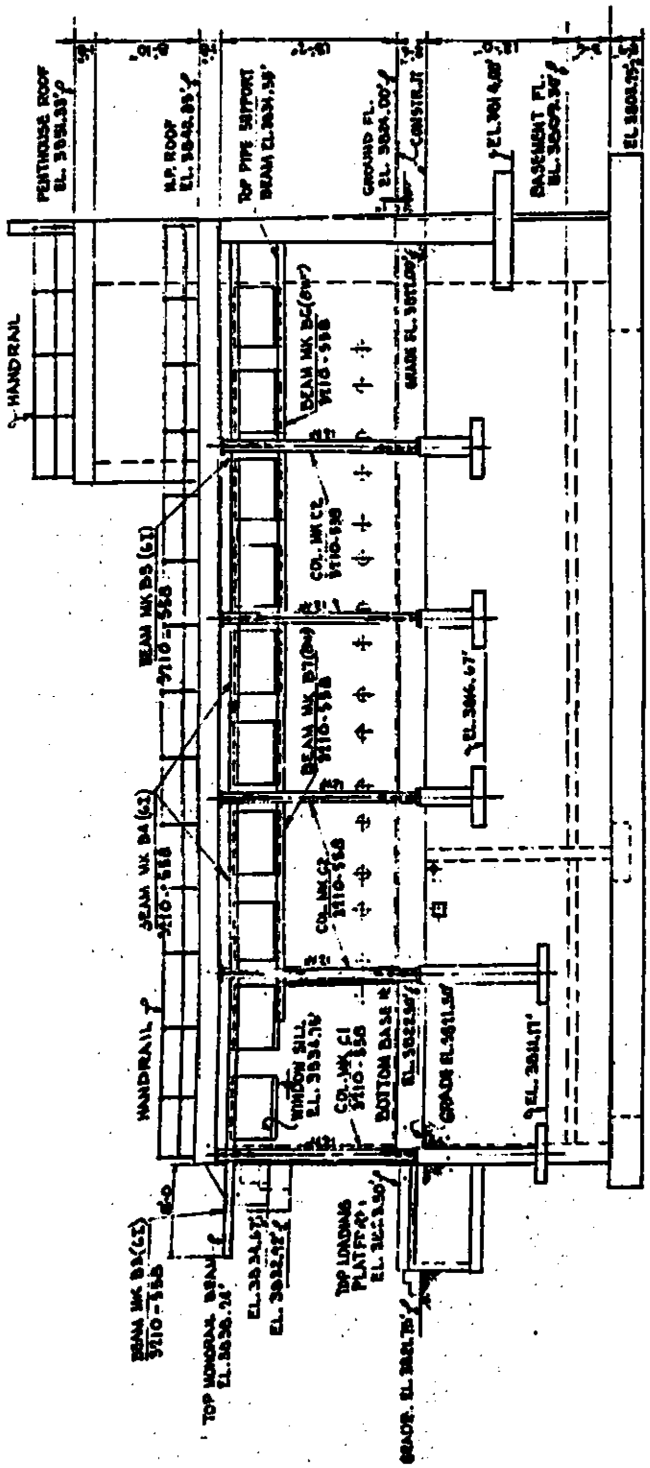

Figure 9. Test Cell C, Building 3210, east elevation, ca. 1960.

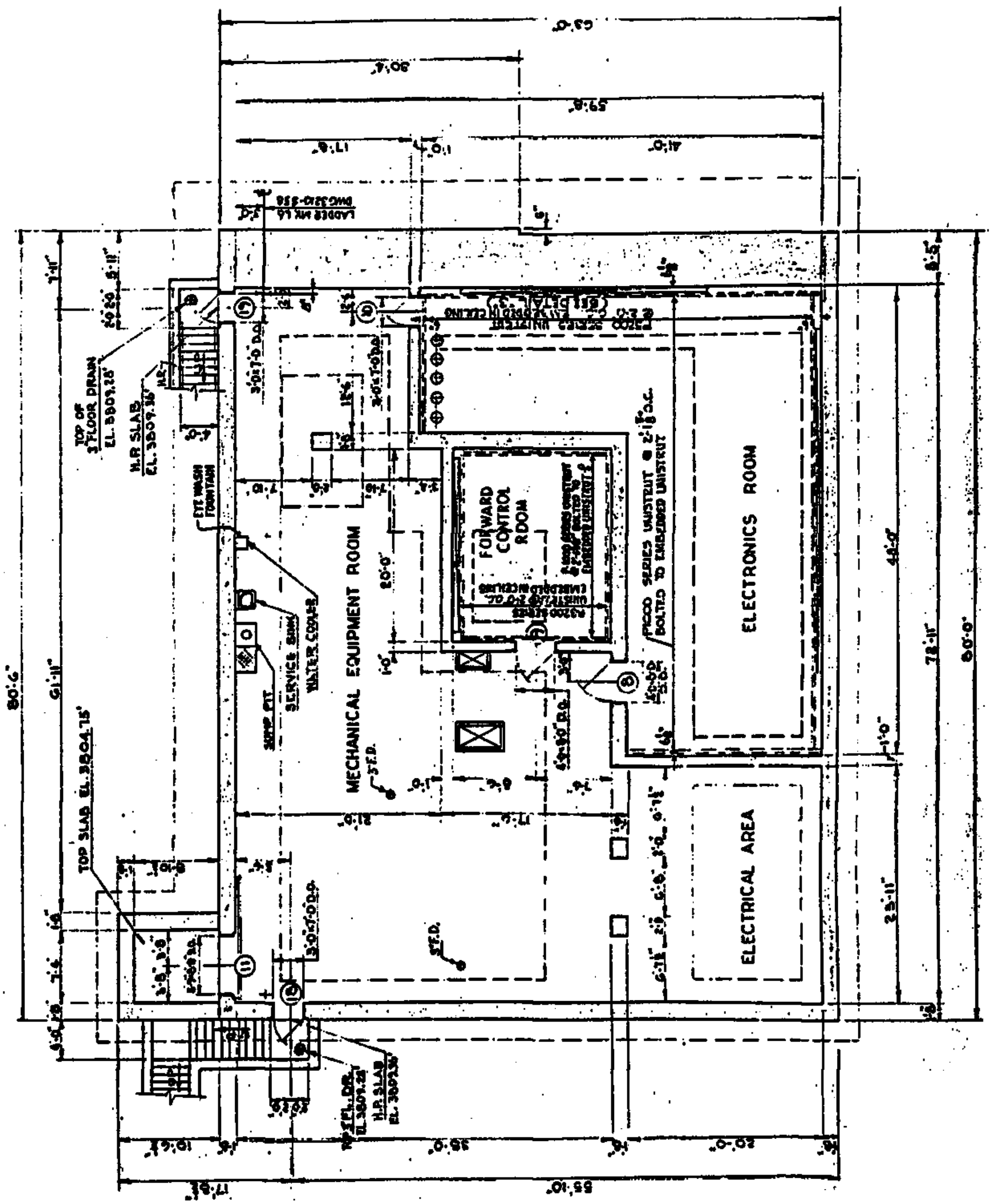

Figure 10. Test Cell C, Building 3210, Basement plan, ca. 1960.

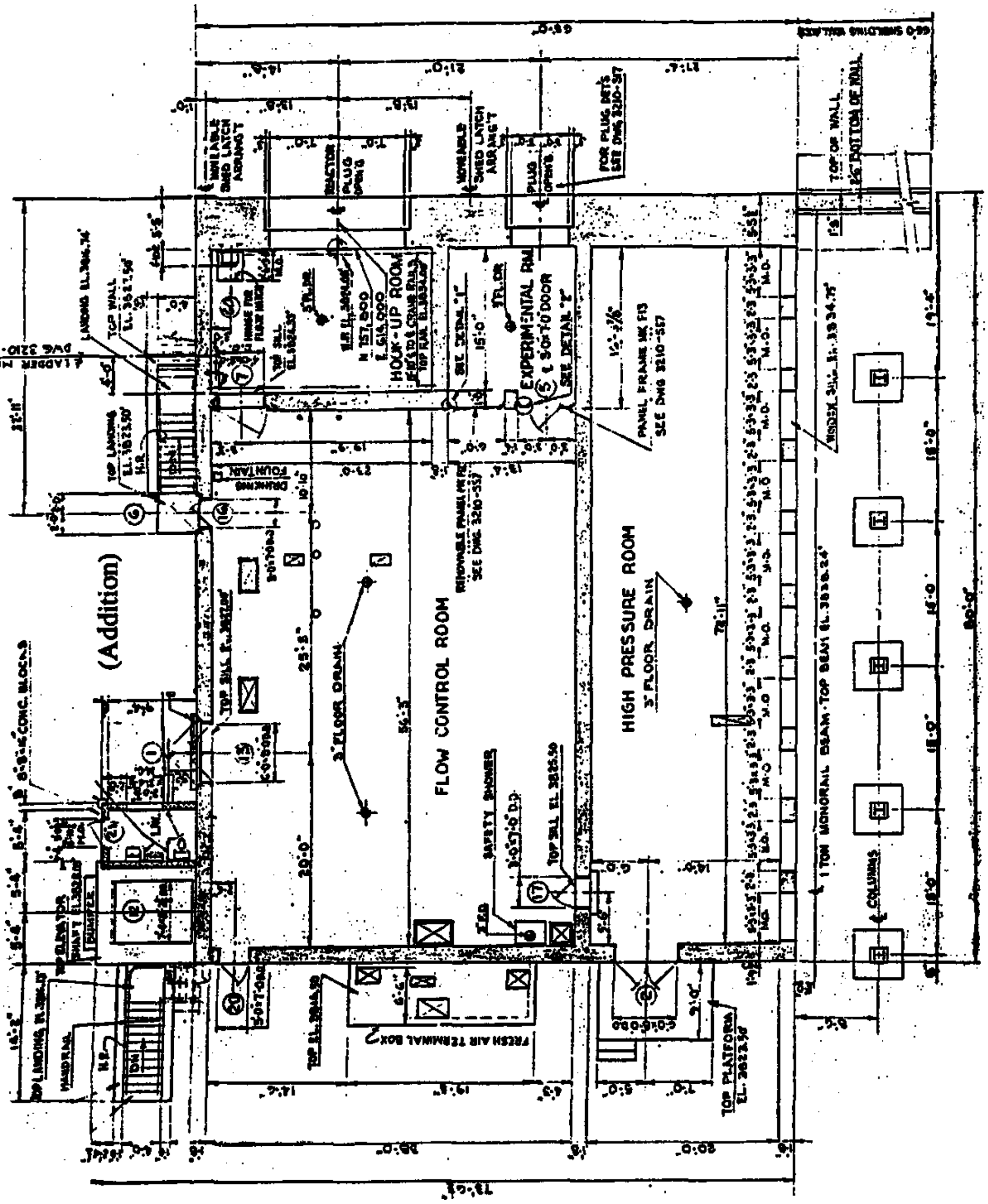

Figure 11. Test Cell C, Building 3210, Floor 1 plan, ca. 1960.

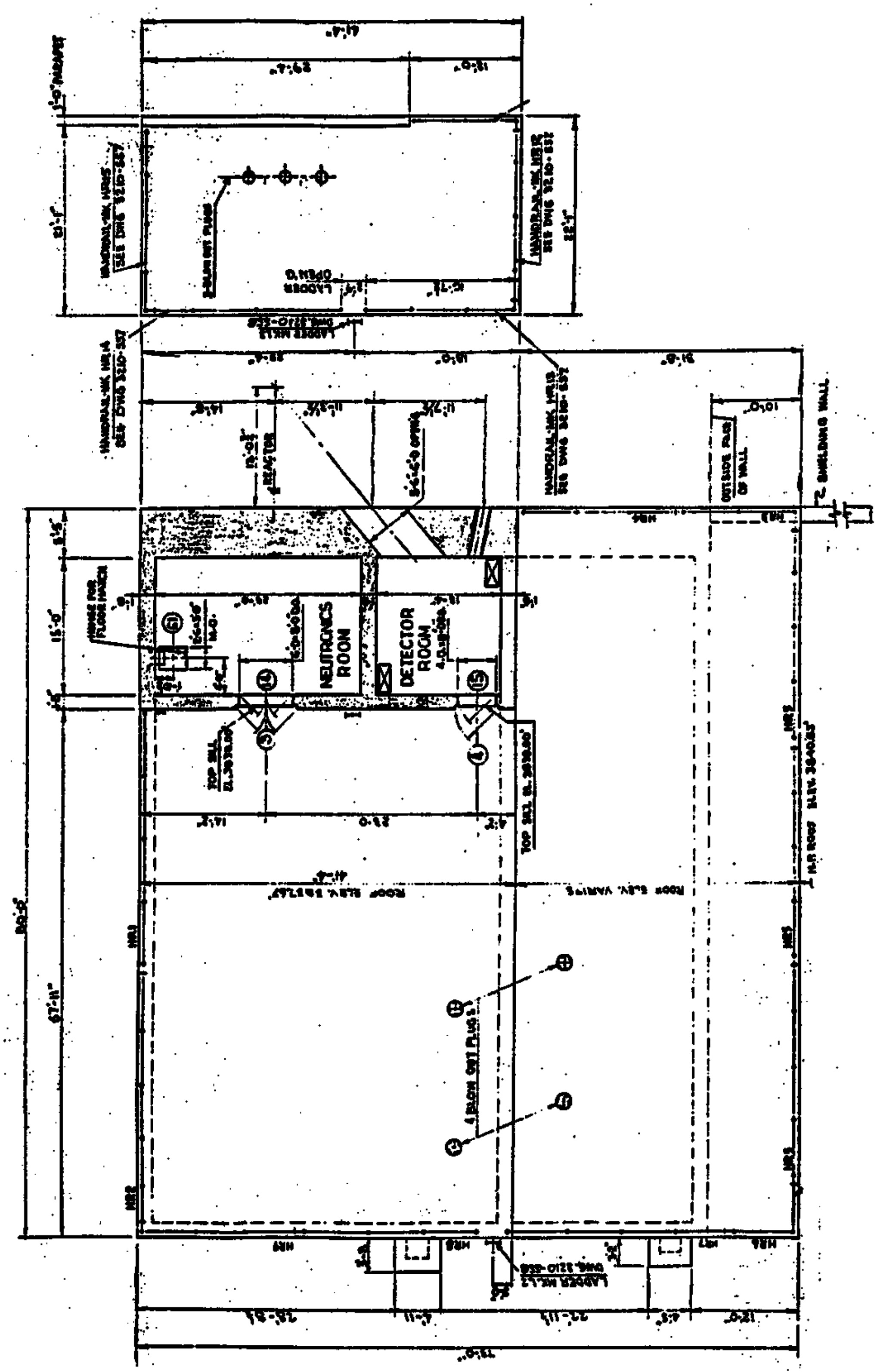

Figure 12. Test Cell C, Building 3210, Penthouse and roof plan, ca. 1960.